Space Weather Technical Forecast

Issued on Saturday, 03 August 2024 at 01:14 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Occasional M-flares expected, chance of X-flares and of exceeding S1/Minor Radiation Storm threshold. Potential further CME glancing blow Day 1 (03 Aug), chance of G1-G2/Minor-Moderate Geomagnetic Storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is Moderate, with occasional M-class flares observed from across the disc, the strongest an M7.4 peaking at 02/0455UTC, from AR3768. An active disc, with thirteen sunspot regions currently on the visible disc. AR3768 has now rotated around the southwestern limb, and has been removed from the table above, however its flare risk has still been included. AR3765, AR3766 and AR3767 remain clustered close together in the southwestern disc. AR3765 and AR3767 are still in very close proximity, with the respective trailing and leading portions sharing a penumbra with a delta spot configuration. AR3767 continues to show some signs of decline with the fading of small trailing spots. AR3772 in the southeast has a small delta spot on one of its central spots and continues to grow, with proliferation of intermediate spots. AR3774 near the southeast limb appears to be another a large and magnetically complex region. AR3775 has continued to show some minor growth in its trailing portion. This region is also large and magnetically complex, with a delta spot located in its intermediate portion. AR3777 has continued to develop with signs of growth, this is now classified as a Cai/Beta. Newly numbered AR3778 in the southwest is a simple Bxo/Beta configuration. All other regions are generally stable or showing some decline.

A large CME was observed from the southwest limb in association with an M7.4 flare from AR3768 at 02/0455UTC, with Type II and Type IV radio emissions. This has been analysed as missing Earth.

A large filament lift-off was observed at 02/1840 UTC south-centre disc in SDO/AIA 304 and GONG imagery. Awaiting LASCO coronagraph imagery for any potential CME associated with this event. Dimming was also evident in imagery.

No other Earth-directed CMEs were observed in the past 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE at L1, was mostly at slightly elevated levels, with a gradual decline towards background, with speeds ranging between 360-450 km/s, under waning weak CME influence. Density started the period at average levels, with a peak of 12ppcc at the start of the UTC day, declining to below average levels. The Interplanetary Magnetic Field, Bt, was moderate to weak, between 2-9nT. The north-south component, Bz, was mostly positive, with some brief negative intervals, ranging from ranged between -5 and +5nT. Phi angle was positive (away from the Sun) until 02/1400 UTC, becoming more negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp2-3).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 was at background levels. High energy electron flux (greater than 2MeV) observed

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at GOES16 was also at background levels. The 24-hour fluence was below the Active threshold with 1e6 integrated pfu observed at 03/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High activity is forecast to continue, with occasional M-class flares expected and a chance of isolated X-class flares.

Solar Wind /Geomagnetic Activity: A possible glancing blow CME may arrive later on Day 1 (03 Aug), although this is low confidence. Furthermore, due to the number of coincident CMEs, further arrivals cannot be ruled out through the period.

No coronal hole fast wind enhancements are expected during the period, with CME arrivals expected to be the main factor of interest. Geomagnetic activity is expected to be generally Quiet to Unsettled, with periods of Active conditions possible and a persistent chance of G1-G2/Minor-Moderate Geomagnetic Storms should any CME arrivals bring more than a glancing blow. In the absence of further CME influence, activity is likely to become mostly Quiet later in the period.

Energetic Particles / Solar Radiation: High energy proton flux is currently at background levels. Should any notable flares occur in the western disc there is a chance of exceeding the S1/Minor Radiation Storm threshold. The high energy electron flux is forecast to be mostly at background levels, although perhaps reaching moderate at diurnal peak by days 3 and 4 (05-06 Aug) in the absence of any CME influence. The associated 24-hour fluence is likely to remain below the Active threshold (1e8 integrated pfu), with a slight chance of exceeding by the end of the period.

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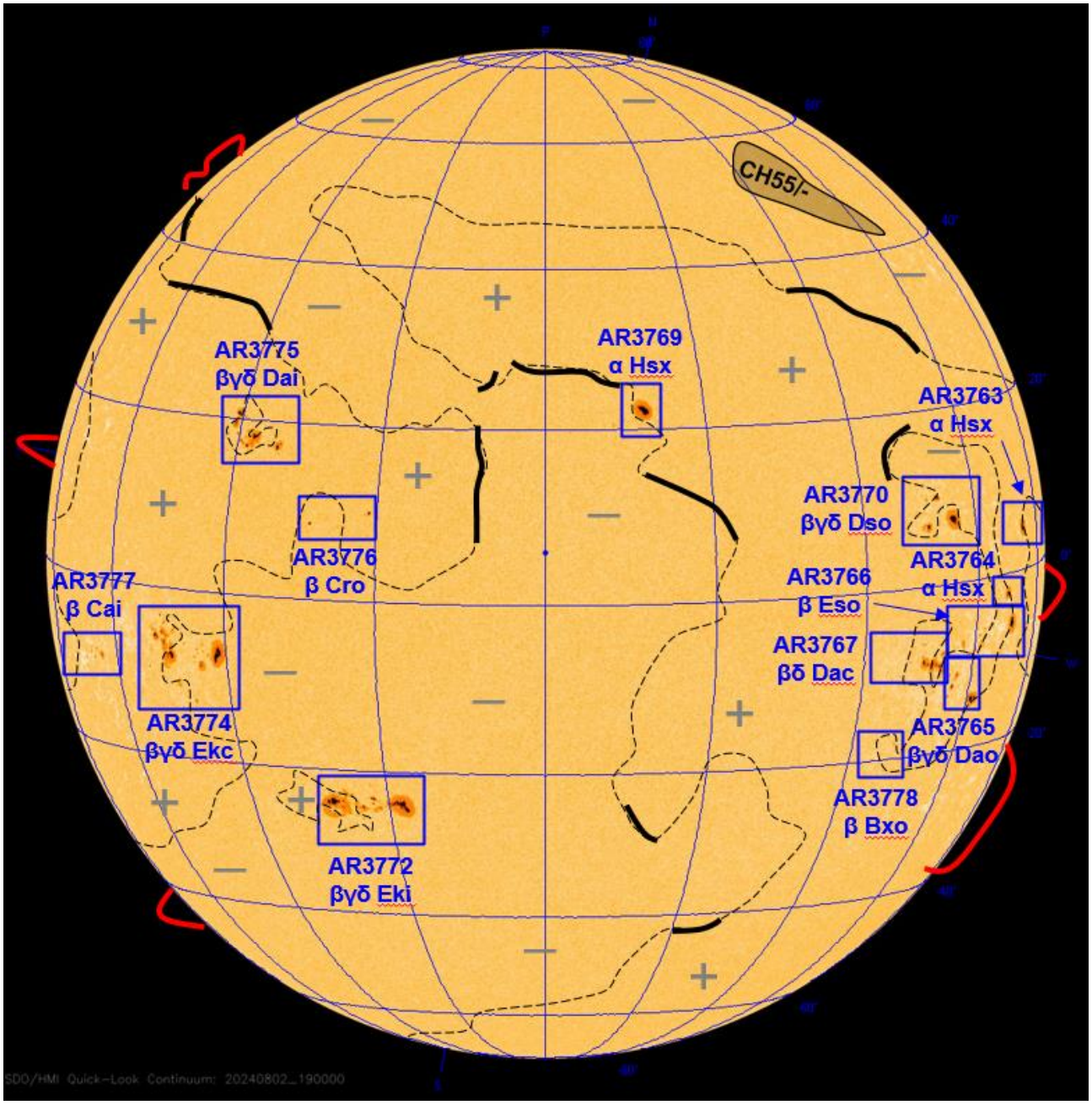
Figure 1. Solar Analysis Valid 02/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Earth is currently experiencing waning weak CME effects from arrivals over the past couple of days. A glancing CME is possible later on Day 1 (03 Aug), associated with a broad CME from the recent M8.2 flare at 01/0709UTC from AR3768 (which has now rotated off the west limb). Analysis of this CME suggests a glancing blow could be possible, however a more direct blow remains a very slight possibility. Due to the large number of coincident CMEs in recent days, including those off the Earth-Sun line, analysis has been more difficult than usual. Consequently further arrivals cannot be ruled out through the period.

A CME was observed to the SW in association with a M7.4 flare from AR3768, peaking at 02/0455UTC. Associated Type II (438km/s) and Type IV radio emissions were recorded, as well as a 440sfu Tenflare. Analysis does suggest that this CME will comfortably miss ahead of Earth's orbit.

No coronal hole fast wind enhancements are expected during the period, with CME arrivals expected to be the main factor of interest. Geomagnetic activity is expected to be generally Quiet to Unsettled, with periods of Active conditions possible and a persistent chance of G1-G2/Minor-Moderate Geomagnetic Storms should any CME arrivals bring more than a glancing blow. In the absence of further CME influence, activity is likely to become mostly Quiet later in the period.

A large filament lift-off (19 degrees in length) was observed at 02/1840 UTC south-centre disc in SDO/AIA 304 and GONG imagery. Awaiting LASCO coronagraph imagery to update to establish if any potential Earth-directed CME was associated with this event. Dimming was also evident in imagery.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	20	5	5
Strong	G3	No	2	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
01/1053	Partial	M8.2 flare	SW limb	1148 km/s	Afternoon 03 Aug	Low confidence glancing blow

Figure 2: MOSWOC Enlil ensemble – shows some members (yellow box) associated with a possible glancing CME on Day 1 (03 Aug) – low confidence.

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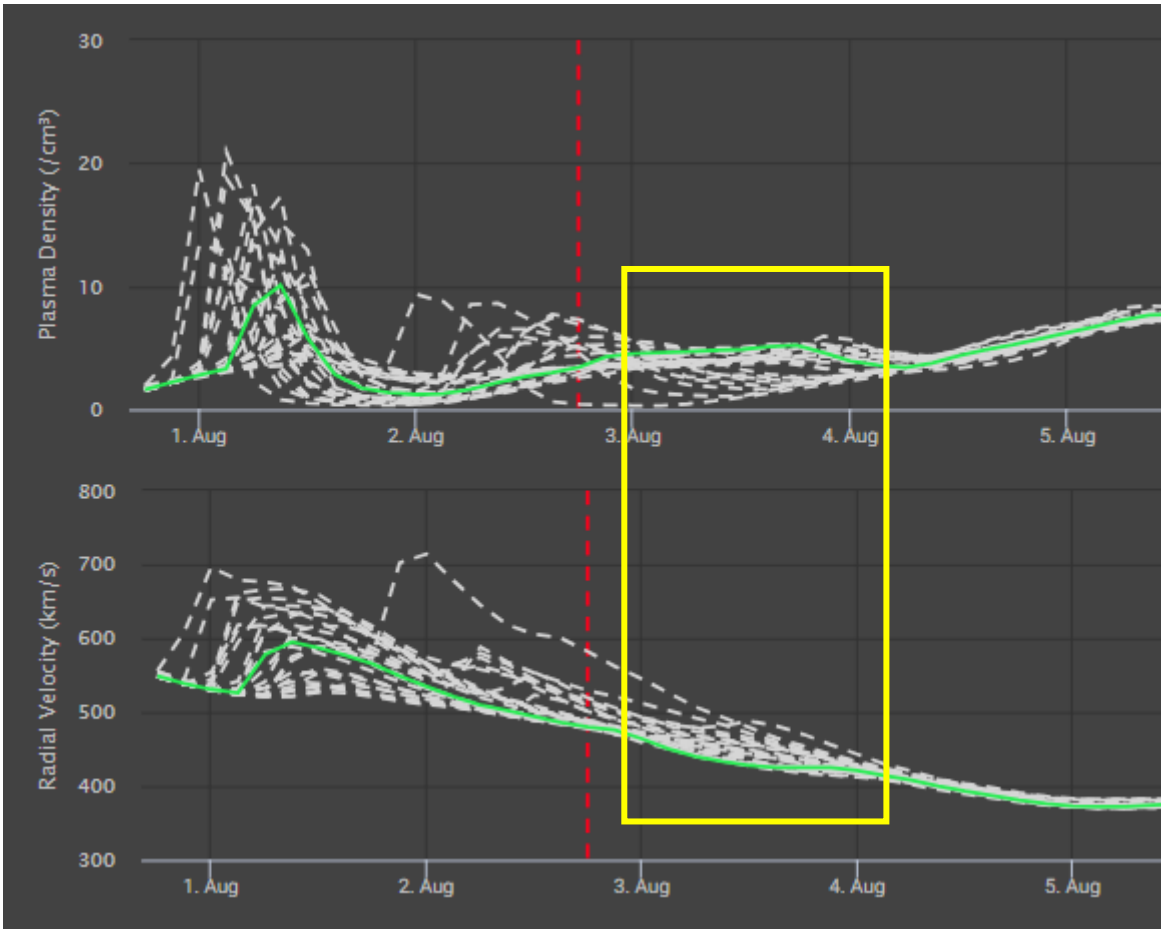

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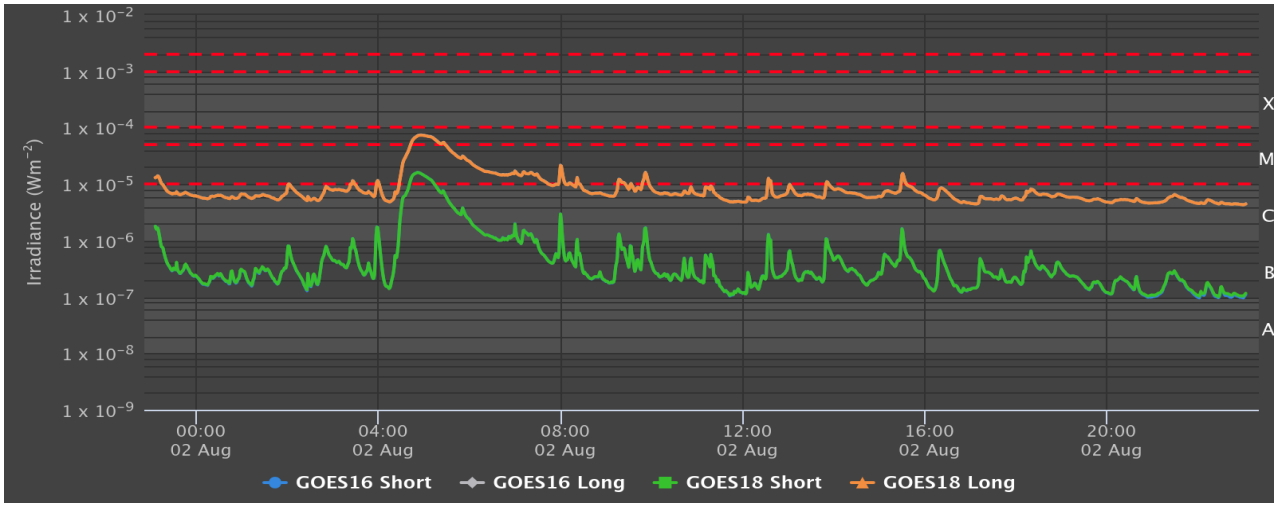
Radio Blackouts - X-Ray Flares:

An highly active disc, with thirteen sunspot regions currently on the visible disc. AR3768 has now rotated around the southwestern limb, however its flare risk has still been included. AR3765, AR3766 and AR3767 remain clustered close together in the southwestern disc. AR3765 and AR3767 are still in very close proximity, with the respective trailing and leading portions sharing a penumbra with a delta spot configuration. AR3767 continues to show some signs of decline with the fading of small trailing spots. AR3772 in the southeast has a small delta spot on one of its central spots and continues to grow, with proliferation of intermediate spots. AR3774 near the southeast limb appears to be another a large and magnetically complex region. AR3775 has continued to show some minor growth in its trailing portion. This region is also large and magnetically complex, with a delta spot located in its intermediate portion. AR3777 has continued to develop with signs of growth, this is now classified as a Cai/Beta. Newly numbered AR3778 in the southwest is a simple Bxo/Beta configuration.

Far-side sounding data suggests the potential for at least one significant oncoming region by the end of this guidance period. Provisionally a slight drop in flare risk is suggested through Days 3-4 (05-06 Aug) as the cluster of active regions in the west begin to leave the disc, although oncoming regions could potentially balance this decline. Overall Moderate to High activity is forecast to continue, with occasional M-class flares expected and a chance of isolated X-class flares given the large number of complex active regions currently on the disc and activity over recent days.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	90	80	70	70
Very Active	R3 to R5 X Class	No	30	25	20	20

Figure 3: GOES18 X-Ray flux trace



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux, as observed by GOES-18, is currently at background levels but has the potential to rise in response to any notable flares on the disc, particularly those from the west of the disc and therefore in a favourable position to give proton enhancement from any significant flare activity. This brings a chance of reaching the S1/Minor Radiation Storm levels, reducing slightly by the end of the period as active regions in the west increasingly rotate away.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	30	25	20	20
Very Active	**≥ S3 ***	No	5	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux levels, as observed by GOES-16, is currently at background having been suppressed by recent CME arrivals. Further CME arrivals are likely to keep the observed flux near background levels in the short term, but recent CME activity is likely to have caused an increase in electron flux below GEO. Assuming CME influence wanes later in the period (an assumption where confidence is low), this will probably be reflected in an increase in electron flux later in the period, with moderate or perhaps high flux becoming possible at the diurnal peak on Days 2-4 (03-05 Aug).

The associated 24hr electron fluence is most likely to remain below Active (1e8 integrated pfu), although with the potential for a rising trend later in the period. MOSWOC REFM output suggests below Active through the period, which is reasonable, but confidence becomes increasingly low.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	5	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM electron fluence

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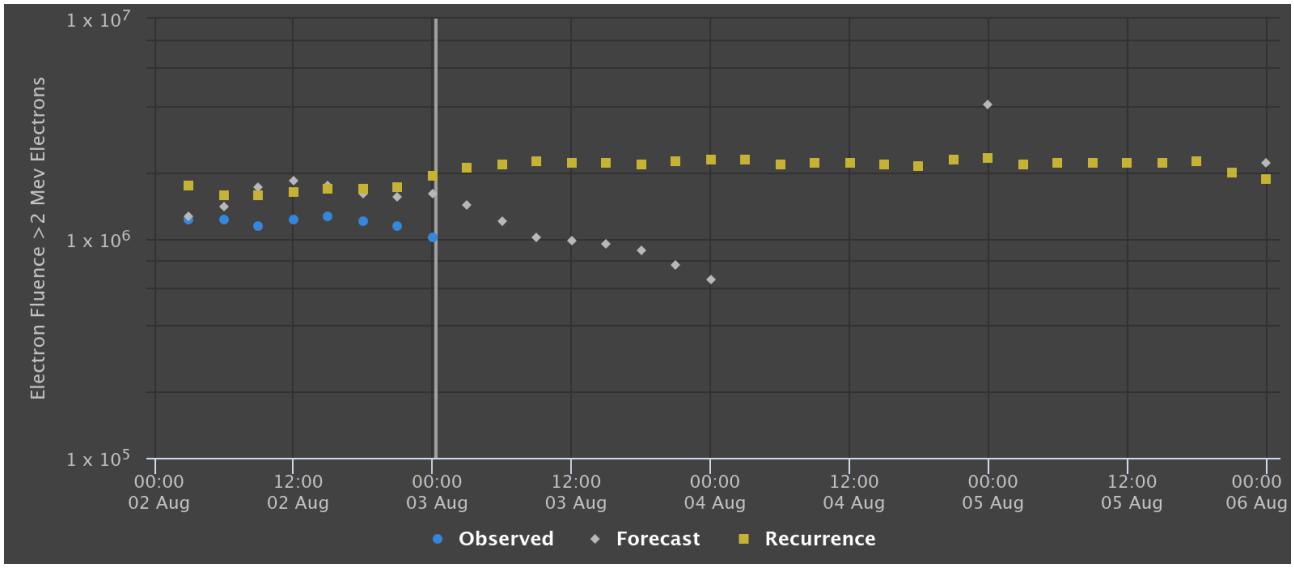

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